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MORPHOLOGY AND DISTRIBUTION OF *BRANCHINELLA KUGENUMAENSIS* (ISHIKAWA), VAR. *MADURAI* RAJ

(BRANCHIOPODA: CRUSTACEA)

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INTRODUCTION

Based on Daday's (1910) monograph on the Anostracan Phyllopoda, Kemp (1911) recorded and described 5 genera, with 5 species and 1 variety representing 4 families of Anostracan Phyllopoda from India. Bond (1934), studying the Indian Anostraca on the basis of large collections of the Indian Museum, described 6 genera with 7 species and 4 subspecies belonging to 4 families. However, the genus *Branchinella* Sayce was first recorded from India by myself (Raj, 1951). Specimens collected very closely resemble *Branchinella kugenumaensis* Ishikawa, but in view of the fact that the frontal appendage in the Indian forms is more spinous, the basal joint of the antenna bears more fleshy processes, the bracts and flabella are of varying shapes, and above all the wide geographic distribution from the type locality in Japan, these have been assigned to a new variety *madurai*. In the present paper a detailed account of its morphology with notes on its distribution is given.

MATERIAL AND METHODS

About 70 specimens were sent to me which were collected by the late Mr. K. J. Joseph in August and December, 1951, from the fresh water ponds in Madura, which is about 300 miles southwest by south of Madras and about 80 miles from the nearest coast line. Subsequent careful survey of the ponds in and around Madras revealed specimens of *Branchinella kugenumaensis* coexisting with *Streptocephalus dichotomus* Baird, at two places, Pallavaram and Tambaram, which are 12 and 17 miles respectively south of Madras, but only about 10 miles from the coast line.

Specimens collected were kept alive for purposes of observation in new earthenware, wide-mouthed vessels which were kept indoors. These proved to be excellent aquaria in view of their porosity, saving the trouble of changing water once a week. Pulped fresh water algal scrapings from stagnant ponds served as satisfactory food for them. Collections in July and August contained ovigerous females, which laid eggs in these aquaria. Eggs were dried in the sun for about a month, which seemed necessary for their hatching in the laboratory.

MORPHOLOGY

Males are readily distinguishable from the females by the complex frontal appendage, biarticulate cylindrical antennae, and a pair of spinous penes. Females besides lacking the frontal appendage, have an unsegmented flat antenna and an ovisac.

In the living state, the body is uniformly flesh colored in both sexes, translucent, so that the tubular alimentary canal and the gonads are visible from the exterior.

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Male.—The abdomen and the caudal furca are together slightly longer than the head and thorax.

Head in the male is prolonged in front of the median eye, as the frontal appendage which lies superior to the antennae. In the living state the frontal appendage is kept either bent twice underneath the head or stretched forwards, when it measures 7 to 8 mm in length. It is three-jointed (fig. 1) and branches thrice on its length. The proximal joint is a mere anterior continuation of the head, subcylindrical and slightly curved ventrally. On either side of the ventromedian line it bears a double row of about 5 pairs of digitiform, two-segmented processes. The second or middle joint is short and straight, bearing ventrally 8 pairs of these processes. At its distal end the middle joint branches into 2 rami, each bearing a single row of such processes. Each ramus branches twice. The inner branch is tapering and is spinous throughout its surface, but the outer branch divides once again for the third and last time. Both of these ultimate branches are rather spinous.

Antennules are unsegmented and filamentous (fig. 2a), each about 4 mm in length. They are located at the base of the eye stalks and at the distal extremity, each bears in addition to 3 long sensory hairs, about 4 to 6 smaller two-segmented blunt processes (fig. 2b).

Antennae (fig. 3) are about 4 mm long, biarticulate, and are located at the base of the frontal appendage. As in males of all the other Anostraca, they are modified here also, and are directed forwards. The basal segment is flattened and fleshy, broadest at its middle point where it bears the distal segment, towards the outer side. The basal segment carries 10 prominent fleshy processes towards the outer margin. The distal segment of the antenna is falciform, more chitinous and movably articulated.

Eyes (fig. 4) are dark and hemispherical and borne on movably articulated stalks. The median or the nauplius eye is at the base of the frontal appendage on a line joining the bases of the 2 antennules. It is elongated anterior-posteriorly, and shows a clear transverse constriction in the middle, giving a bilobed appearance.

Labrum (fig. 5) is a continuation of the head beneath the frontal appendage, roughly triangular and directed backwards. It has a dense setose margin and at the free end is drawn into a tonguelike process. The labral glands are prominent.

Mandibles (fig. 6a) are club-shaped on either side of the mouth, with hollow and narrow proximal ends inserted to muscles, and the free end has 2 ridges with fine denticles and larger spines at the anterior end (fig. 6b). No palps are noticeable.

Maxillulae (fig. 7) are small, unsegmented, and flat with the free margin fringed with 17 to 18 biarticulate plumose setae.

Maxillae are very rudimentary, irregularly lobed with few setae, but often inconspicuous.

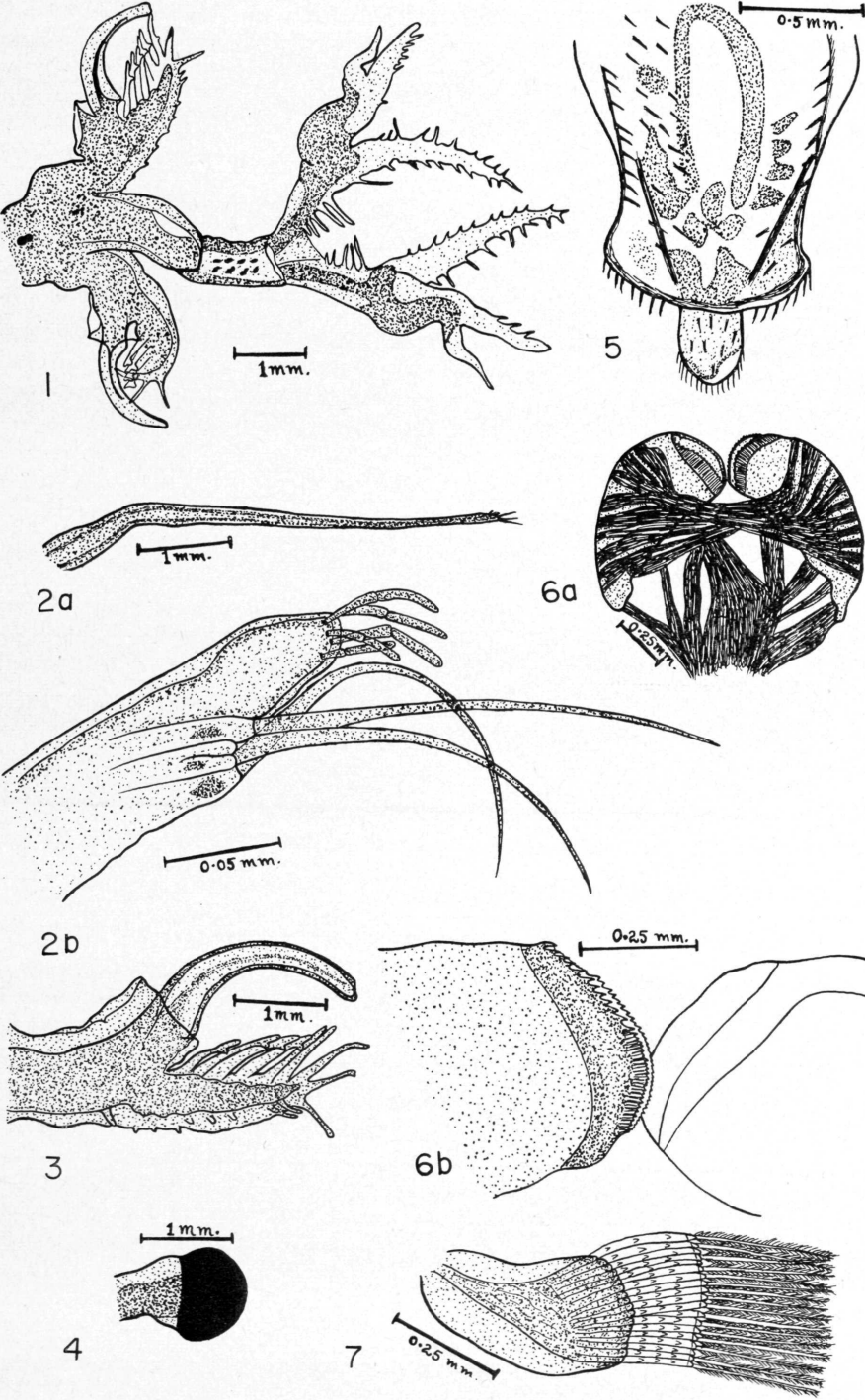
Thorax bears 11 distinct pedigerous segments, each with a pair of phyllopodia. The anterior ones are noted to be slightly smaller than the posterior ones.

Phyllopodia (fig. 8) are flat and leaflike. Of the 6 endites toward the interior, the distal most one is the largest, usually circular, but in some cases bifid by a notch. The setae along its margin are reduced to short spines. The proximal most endite bears very long plumose setae, whereas the intermediate endites are small, conical, each bearing 3 to 5 setae. Towards

EXPLANATION OF FIGURES

Branchinella kugenumaensis (Ishikawa), var. *madurai* Raj.

- FIGURE 1. Frontal appendage and antennae of male.
 2a. Antennule of male.
 2b. Tip of antennule.
 3. Antenna of male.
 4. Eye.
 5. Labrum.
 6a. Mandibles.
 6b. Mandibular edge.
 7. Maxillula.



the exterior the phyllopodium carries the exite (epite) at the proximal end whose shape is uniform in all the appendages, circular and with a crenulate margin. The bract or the gill is fleshy or succulent, and has no setae. It is semicircular or tongue-like and the shape varies very much in various appendages. The flabellum bears the longest plumose setae, especially helpful in swimming. It is smaller than the bract in the anterior as well as the posterior appendages, but in the middle ones, it attains large proportions.

Running along the ventromedian line of the thorax and bound on either sides by the basal endites of the phyllopodia, there is the median food groove, along which food particles are wafted to the mouth.

Abdomen bears 9 post-pedigerous (abdominal) segments, of which the penultimate one is the longest and the last one bearing the caudal furca is the shortest. The first 2 abdominal segments are continuous ventrally forming the genital segments bearing the genital organs.

Penis is a retractile and eversible structure. The basal portion constituting the sheath is noneversible and extends to the middle of the third abdominal segment (fig. 9a). In the retracted condition, the penis lies folded within the abdominal cavity, but when projected, extends to the hind end of the fourth abdominal segment and may measure about 4 mm in length. This distal intromittant part is vermiform and curved, and bears proximally directed spines all over its surface (fig. 9b). The basal part of this intromittant penis bears a blunt, non-spinous apophysis.

Caudal furca (fig. 10) consists of 2 cercopods, movably articulated to the last abdominal segment. The anus lies between these 2 cercopods. Each cercopod is lanceolate and is fringed at both margins with long plumose setae.

Average dimensions of an adult male.—Total length, 23.5 mm; head and thorax, 11 mm; abdomen, 9 mm; caudal furca, 3.5 mm.

Female.—Head is rounded, smooth, and unarmed.

Antennae (fig. 11) are unsegmented, flattened, and leaflike, twice as long as their width. Distally, the outer end is prolonged as an acutely pointed process. Each antenna is about 2 to 3 mm long and bears sparse setose margin.

Abdomen is distinctly longer than the head and trunk in the female.

Ovisac is about 5 to 6 mm long, ventrally attached to the genital segments by its front end. Posteriorly it is free from the abdomen (fig. 12a) and extends up to the middle of the sixth abdominal segment. It is globular at its proximal end (fig. 12b) and abruptly narrows towards the posterior end. At its free extremity, there is a transverse slit bound by upper and lower lips for the exit of eggs.

Eggs (fig. 13) in each ovisac at a time may be 200 to 250. They are round, cream colored, and measure about 0.3 to 0.4 mm in diameter, and are externally sculptured with hexagonal facets.

Average dimensions of an adult female.—Total length, 26.5 mm; head and thorax, 10 mm; abdomen, 13.0 mm; caudal furca, 3.5 mm.

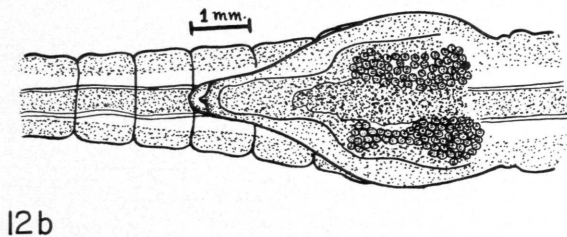
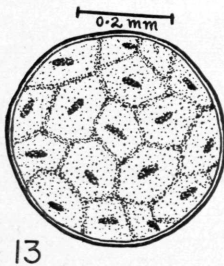
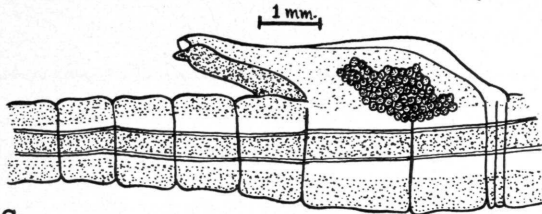
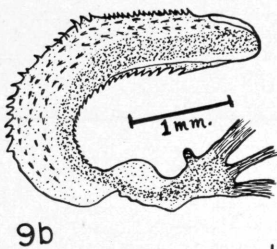
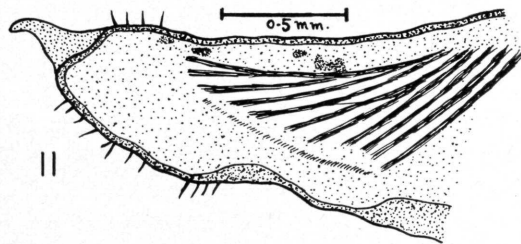
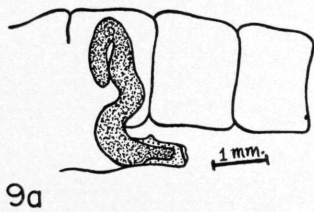
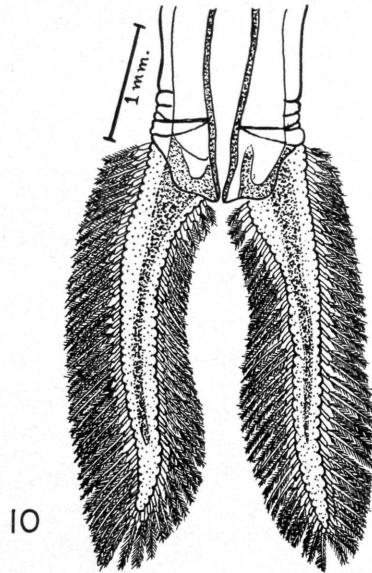
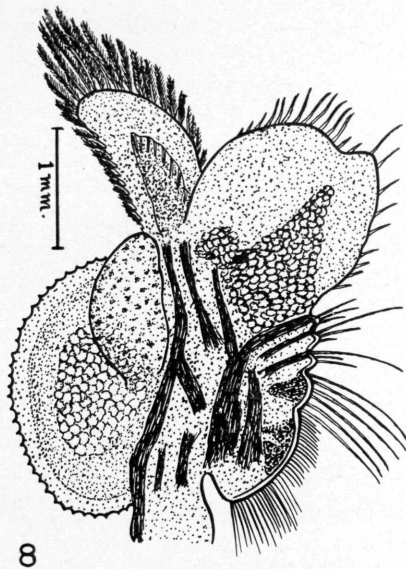
GEOGRAPHIC DISTRIBUTION

Branchinella kugenumaensis (Ishikawa) is at present known to be distributed in Kugenema, Peiping, Chefoo, Hopei, Shantung, Sagami, Tokyo, Osaka, Chosen, and Nanking.

EXPLANATION OF FIGURES

Branchinella kugenumaensis (Ishikawa), var. *madurai* Raj.

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| FIGURE | 8. | Phyllopodium. |
| | 9a. | Penis retracted. |
| | 9b. | Penis extended. |
| | 10. | Caudal furca. |
| | 11. | Antenna of female. |
| | 12a. | Ovisac (lateral view). |
| | 12b. | Ovisac (ventral view). |
| | 13. | Egg. |



In South India, it is so far known from Madura in the Madura district, and from Pallavaram and Tambaram in the Chingleput district of the Madras State. It is difficult to account for this discontinuous distribution in Japan and China at one extremity and in South India at the other. However, it is well known since ancient times that the fresh water entomostracans, especially the Phyllopods, have means of wide distribution to the remote corners of the globe through the agency of their resistant eggs, usually transported attached with mud to the feet of wading migrant birds, or through other means.

SUMMARY

The genus *Branchinella* Sayce is reported from 2 localities in South India and the morphology of a new variety of *Branchinella kugenumaensis* (Ishikawa) is described. The disjunct distribution of this species and the geographic isolation of the variety are indicated.

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